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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/675,627	09/29/2000	Michael Rumer	M-8570 US	9578

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EXAMINER	
PERKINS, PAMELA E	
ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 08/28/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/675,627	RUMER ET AL.	
	Examin r	Art Unit	
	Pamela E Perkins	2822	

-- Th MAILING DATE of this communication appears on th cover sheet with th correspond nc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 May 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 September 2000* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 7 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

This office action is in response to the filing of the amendment on 30 May 2002. Claims 1-22 are pending.

Drawings

The drawings are objected to because under 37 CFR 1.84(k) all drawings must be made by a process which will give them satisfactory reproduction characteristics. Every lines, number, and letter must be durable, clean, black (except for color drawings), sufficiently dense and dark, and uniformly thick and well-defined. The weight of all lines and letters must heavy enough to permit adequate reproduction. Correction is required. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 4, 9, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. (6,130,156) in view of Lin et al. (6,165,861).

Havemann et al. disclose a method of forming a layer on a substrate where a titanium layer (9) is formed, in an argon-hydrogen environment, on a substrate (1), then forming a titanium nitride layer (not shown) over the titanium layer (9) and forming an

aluminum layer (11) over the titanium nitride layer (not shown) (col. 3, line 54 thru col. 4, line 14). Havemann et al. do not disclose depositing the titanium layer by physical vapor deposition (PVD), such as sputter deposition.

Lin et al. disclose a method of forming a layer over a substrate where a titanium layer is sputter deposited by PVD over a substrate (col. 2, lines 22-29; col. 5, lines 43-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Havemann et al. by forming the titanium layer by PVD as taught by Lin et al. to prevent hydrogen diffusion.

Claims 3, 18, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Lin et al. as applied to claims 1, 2, 4, 9 and 10 above, and further in view of Yamadai (6,083,830).

Havemann et al. disclose a method of forming a layer on a substrate where a titanium layer (9) is formed, in an argon-hydrogen environment, on a substrate (1), then forming a titanium nitride layer (not shown) over the titanium layer (9) and forming an aluminum layer (11) over the titanium nitride layer (not shown) (col. 3, line 54 thru col. 4, line 14). Havemann et al. do not disclose the titanium layer having a <002> orientation, the titanium nitride layer having a <111> orientation and the aluminum layer having a <111> orientation.

Yamadai discloses a method of forming a layer on a substrate where a titanium layer (3), with a <002> orientation, is sputter deposited on a substrate (1), then a titanium nitride layer (4), with a preferred <111> orientation, is formed on the titanium layer (3) and an aluminum layer (5), with a <111> orientation, is formed on the titanium

nitride layer (4) (col. 2, lines 21-55; col. 3, line 17 thru col. 5, line 41; col. 5, lines 1-33). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Havemann et al. by the titanium layer having a <002> orientation, the titanium nitride layer having a <111> orientation and the aluminum layer having a <111> orientation as taught by Yamadai. A titanium layer with a <002> orientation prevents the formation of side-hole, openings in the sidewalls.

Claims 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Liu et al. and Yamadai as applied to claims 1-4, 9, 10,18, 20 and 21 above, and further in view of Freeman et al. (5,466,522).

Havemann et al. disclose a method of forming a layer on a substrate where a titanium layer (9) is formed, in an argon-hydrogen environment, on a substrate (1), then forming a titanium nitride layer (not shown) over the titanium layer (9) and forming an aluminum layer (11) over the titanium nitride layer (not shown) (col. 3, line 54 thru col. 4, line 14). Havemann et al. do not disclose the gas mixture during sputter deposition comprising at least 0.1 mole percent hydrogen.

Freeman et al. a method of forming a layer over a substrate where a substrate is placed in a sputter chamber containing a gas mixture of argon and hydrogen in the atmosphere and sputter depositing a layer over the substrate. Freeman et al. further disclose the gas mixture comprising at least 4 mole percent hydrogen (col. 4, lines 7-57). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Havemann et al. by the gas mixture during sputter

deposition comprising at least 4 mole percent hydrogen as taught by Freeman et al. The higher the concentration of hydrogen in the atmosphere during sputter deposition there is an increase in the coercivity of the film formed on the substrate, meaning the polarity of the material changes only under the influence of a relatively large magnetic field.

Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Liu et al. and Yamadai as applied to claims 1-4, 9, 10,18, 20 and 21 above, and further in view of Kaloyeros et al. (6,139,922).

Havemann et al. disclose a method of forming a layer on a substrate where a titanium layer (9) is formed, in an argon-hydrogen environment, on a substrate (1), then forming a titanium nitride layer (not shown) over the titanium layer (9) and forming an aluminum layer (11) over the titanium nitride layer (not shown) (col. 3, line 54 thru col. 4, line 14). Havemann et al. do not disclose providing power to the target with a power density of 3 to 8 watts per square centimeter.

Kaloyeros et al. disclose a method of forming a film over a substrate by a method of sputtering. Kaloyeros et al. further disclose the power used in the sputtering method having a power density of between 0.01 W/cm^2 and 10 W/cm^2 (col. 10, lines 60-67; col. 11, lines 1-17). It would have obvious to one of ordinary skill in the art at the time the invention was made to modify Havemann et al. by applying powering to the target with a power density of 0.01 W/cm^2 to 10 W/cm^2 as taught by Kaloyeros et al. Under such conditions undesirable film contamination and electrical damage to the film are prevented.

Claims 11-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Liu et al., Yamadai and Kaloyeros et al. as applied to claims 1-4, 6, 7, 9, 10, 18, 2 0 and 21 above, and further in view of Miyasaka (6,124,154).

Havemann et al. disclose a method of forming a layer on a substrate where a titanium layer (9) is formed, in an argon-hydrogen environment, on a substrate (1), then forming a titanium nitride layer (not shown) over the titanium layer (9) and forming an aluminum layer (11) over the titanium nitride layer (not shown) (col. 3, line 54 thru col. 4, line 14). Havemann et al. do not disclose a first gas injector introducing argon and hydrogen and a second gas injector introducing an inert gas in the sputter chamber.

Miyasaka discloses a method of forming a thin film over a substrate (10) in an atmosphere on hydrogen in argon with an inert gas (col. 5, lines 57-67; col. 6, lines 1-25). It would have obvious to one of ordinary skill in the art at the time the invention was made to modify Havemann et al. by the first gas injector introducing argon and hydrogen, the second gas injector introducing an inert gas into the atmosphere as taught by Miyasaka because under such conditions the semiconductor atoms are easily scattered to produce high purity layers.

Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Liu et al. and Yamadai as applied to claims 1-4, 9, 10,18, 20 and 21 above, and further in view of Hsu et al. (6,329,282).

Havemann et al. disclose a method of forming a layer on a substrate where a titanium layer (9) is formed, in an argon-hydrogen environment, on a substrate (1), then forming a titanium nitride layer (not shown) over the titanium layer (9) and forming an

aluminum layer (11) over the titanium nitride layer (not shown) (col. 3, line 54 thru col. 4, line 14). Havemann et al. do not disclose the aluminum layer with a full width at half maximum (FWHM) x-ray diffraction signal of less than about 1.5 degrees.

Hsu et al. disclose a method of forming a titanium (9), titanium nitride (11), aluminum (19) interconnect. Hsu et al. further disclose the aluminum layer having a FWHM of 1.5 degrees (col. 3, lines 11-65). It would have obvious to one of ordinary skill in the art at the time the invention was made to modify Havemann et al. by the aluminum layer having a FWHM of 1.5 degrees as taught by Hsu et al. because it improve the crystallographic orientation of the aluminum layer.

Hsu et al. do not disclose the aluminum layer having a FWHM of less than 1.5 degrees. It would have been obvious to one having ordinary skill in the art at the time invention was made to have a FWHM of less than 1.5 degrees for the aluminum layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Stephen D. Meier
Primary Examiner